NASA TECH BRIEF

Shock and Vibration Response of Multistage Structure

An analytical and experimental study has been made on the shock and vibration response of a multistage structure, in this case a space rocket vehicle. Analytically, lumped-mass, continuous-beam, multimode, and matrix-iteration methods were applied. Experimentally, a special technique was used in conjunction with a mechanical shaker. The study was made on the load paths, transmissibility, and attenuation properties along a longitudinal axis of a long, slender type of structure with increasing degree of complexity including ring frames, longerons, bulkheads, propellant fluid, payload mass (spacecraft), as well as multistage structures. Free vibration characteristics were analytically solved by lump masses and continuous beam approaches. A modal approach was applied to determine shock responses to various phases of different forms and durations for a multidegree-of-freedom system. In the experimental phase of the study, a special technique was employed to produce pulses of varying durations by a mechanical shaker. The test results verified the analytical predictions to a satisfactory degree.

Notes:

1. Longitudinal forced response to various pulses of different forms and durations can be easily calculated for slender or multistage structures, as in bridge support towers, multistory building supports and the like. Solutions obtained are peak responses and complete shock wave propagation along the axial stations within the structure.
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
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   Huntsville, Alabama 35812
   Reference: B68-10353

Patent status:

No patent action is contemplated by NASA.

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